



**NAVRACHANA
UNIVERSITY**

a UGC recognized University

School: School of Engineering and Technology
Program/s: B. Tech (ME)
Year: 2nd **Semester:** III
Examination: End Semester Examination
Examination year: November 2023

Course Code: ME222

Date: 22/11/2023

Time: 1 pm to 3 pm

Course Name: Numerical Methods and Computer Programming

Total Marks: 40

Total Pages: 01

Instruction:

→ Use of a calculator is permitted.

| Q. No. | Details | Marks | COs* | BTL# | | | | | | | | | | | | |
|------------|---|-------------|-------------|-------------|-----|---|---|---|-----|-----|-----|-----|-----|--|--|--|
| Q.1 | Attempt following questions. (1 Mark each) | [4] | | | | | | | | | | | | | | |
| | 1) Newton's method convergences faster than the Bisection method. (True / False) | | | | | | | | | | | | | | | |
| | 2) Gauss-Elimination method solves _____. (system of linear equations/non-linear equations) | | CO1 | BT1, BT2 | | | | | | | | | | | | |
| | 3) What is the stopping criteria of Newton-Raphson method? | | | | | | | | | | | | | | | |
| | 4) Newton forward interpolation formula is used for _____ width of intervals. (equal / unequal) | | | | | | | | | | | | | | | |
| Q.2 | Attempt Any THREE: (7 Marks each) | [21] | | | | | | | | | | | | | | |
| | 1) Given the equations, $10x + y + z = 12$, $2x + 10y + z = 13$, $x + y + 3z = 5$. Solve by Gauss elimination method. Show all steps of the computation. | | | | | | | | | | | | | | | |
| | 2) Apply Newton-Raphson method to compute the value of $(25)^{1/4}$. Try 5 iterations. | | CO1, CO2 | BT1, BT3 | | | | | | | | | | | | |
| | 3) Fit the polynomial using Lagrange's interpolation method for the following data: (-1, 7), (1,5), (2,15) | | | | | | | | | | | | | | | |
| | 4) Determine the values of y for $x = 0.02$, given that $y(0) = 1$ and $y' = y + x^2$ using Runge-Kutta method. Step size is 0.02. | | | | | | | | | | | | | | | |
| Q.3 | Answer in short: (1 mark each) | [3] | | | | | | | | | | | | | | |
| | (i) Euler method solves ____ order differential equation. (first / second) | | CO2, CO3 | BT3, BT4 | | | | | | | | | | | | |
| | (ii) Write difference between Jacobi and Gauss-Seidel method. | | | | | | | | | | | | | | | |
| | (iii) _____ package is useful in drawing graphs in python. (matplotlib / scipy) | | | | | | | | | | | | | | | |
| Q.4 | Attempt Any TWO: (6 Marks each) | [12] | | | | | | | | | | | | | | |
| | 1) Apply Simpson's 1/3 rule to find the integral $I = \int_0^1 \sqrt{1-x^2} dx$ for 10 subintervals. Find h using $n = 10$. | | | | | | | | | | | | | | | |
| | 2) Consider the differential equation $y' = -y$, with the initial condition $y(0) = 1$ and step size is 0.01. Find solutions y_1, y_2, y_3 , and y_4 using Euler's method. Find exact solution and compare it with numerical solution. | | CO3, CO4 | BT3, BT4 | | | | | | | | | | | | |
| | 3) Using least square method, find the values of a_0 and a_1 so that $y = a_0 + a_1 x$ fits the data given in the table. | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>x</th> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <th>y</th> <td>1.0</td> <td>2.9</td> <td>4.8</td> <td>6.7</td> <td>8.6</td> </tr> </tbody> </table> | x | 0 | 1 | 2 | 3 | 4 | y | 1.0 | 2.9 | 4.8 | 6.7 | 8.6 | | | |
| x | 0 | 1 | 2 | 3 | 4 | | | | | | | | | | | |
| y | 1.0 | 2.9 | 4.8 | 6.7 | 8.6 | | | | | | | | | | | |